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Degradable Mulch Evaluation

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Abstract
Plastic mulches can provide vegetable growers with earlier crop maturity, better yields and quality, improved disease, insect and weed control, and more efficient fertilizer and water use. The downside of using mulches is the high cost of installation and removal and disposal at the end of the season. A partial solution to this problem has been the development of degradable mulches, which can be left in the field at the end of the season, eliminating removal costs.

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Introduction

Plastic mulches can provide vegetable growers with earlier crop maturity, better yields and quality, improved disease, insect and weed control, and more efficient fertilizer and water use. The downside of using mulches is the high cost of installation and removal and disposal at the end of the season. A partial solution to this problem has been the development of degradable mulches, which can be left in the field at the end of the season, eliminating removal costs. There are different types of degradable mulches. Photodegradable mulches, which start breaking down when exposed to light, have been available for several years, but their use has been limited because of their tendency to breakdown unevenly leaving large pieces of plastic in the field longer than desired. Another type, called biodegradable, is made from plant byproducts such as corn starch and when exposed to moisture and the right temperatures are broken down by soil microbes into harmless substances, mostly carbon dioxide and water. In an effort to help growers determine whether degradable mulches are a viable alternative for them, this project evaluated both biodegradable and photodegradable mulches for ease of use, speed of breakdown, and how they influence performance of transplanted muskmelon.

Materials and Methods

This evaluation included five mulch treatments: a clear and a black biodegradable mulch (trade name BioTelo) from Dubois Agrinovation, Quebec, Canada; a clear and a black photodegradable mulch from Poly Expert, Inc., Quebec, Canada; and a black embossed plastic film (non-degradable), also from Poly Expert Inc. All mulches were 4 ft wide. The two biodegradable mulches were 0.6 mil thick and the three from Poly Expert, Inc. were 0.9 mil thick. Mulch treatments were laid in the field on April 28 using a Rain Flo raised bed mulch layer. Trial design was a randomized complete block with three replications. A plot consisted of a single row of mulch 50 ft long. Muskmelon plants, cultivar Aphrodite, were transplanted on May 13 using a Holland pot transplanter capable of planting through mulch. Weed control was achieved by applying Prefar herbicide to beds before laying mulch and applying Strategy and Sandea herbicides between the beds. Normal cultural practices were followed for irrigation, fertilization, and pest control. A low (8:00 a.m.) and high (4:00 p.m.) soil temperature reading was taken from the center of the bed at 4 in. depth from all plots on six dates: May 7, 11, 15, 18, 22, and 25. Mulch tensile strength (puncture resistance) was measured once a month with a Chatillon digital force gauge. Mature muskmelon fruit were harvested and weighed from July 13 through July 31 to determine effect of mulch treatment on early and total yield.

Results and Discussion

The two biodegradable mulches came on rolls 48 in. x 4,000 ft and were similar to standard plastic mulch but were thinner (0.6 mil thickness). The clear biodegradable mulch, in particular, was quite fragile and difficult to install, or run a transplanter over, without tearing or puncturing. In fact, we couldn't use the press wheels on our transplanter without stretching and splitting the clear biodegradable mulch. The black biodegradable mulch was also brittle but not to the extreme of the clear mulch and was easier to use. The photodegradable and the black embossed mulches were installed and planted on without too much difficulty.

Soil temperature readings taken from mulched beds during May revealed that all mulch treatments raised soil temperatures over bare ground readings (Table 2) and the clear mulches raised temperatures the most. An interesting observation was made that soil temperatures under the clear and black biodegradable mulches ran cooler than they did under their photodegradable counterparts.

Muskmelon yield data were taken from July 13 until July 31 and results summarized in Table 1. In general, yields were good for all mulch treatments but interestingly, the standard black embossed plots produced the highest total yield. There were no significant differences between the degradable mulches for total yield. The clear biodegradable treatment had smaller fruit size than the other treatments. This might be because a higher percentage of the fruits were harvested early season when fruit size tended to be smaller or it might be due to more weed competition in the clear biodegradable plots (due to premature tearing). Usually, clear mulch will warm the soil more than black mulch, stimulating faster plant growth and higher early yield. Yield results in Table 1 reveal that the clear biodegradable mulch produced the highest early yield and the black biodegradable mulch produced the lowest.

Overall, the season experienced close to normal temperatures but above average rainfall. Vine growth for all treatments was rapid after May 13 transplanting and by June 12 foliage cover of mulch was estimated at 75 percent. At this time, the clear biodegradable mulch was already getting brittle and showing large tears through which weeds were growing. All other mulch treatments were still intact and providing good weed control. A digital force meter was used to record puncture resistance of the mulches and readings are presented in Table 3. Note that the clear and black biodegradable mulches gave the weakest readings and the clear photodegradable mulch gave the strongest readings, at least until August and the end of harvest. The black embossed mulch provided steady readings through the season and maintained enough tensile strength to be easily pulled up for disposal in September. By mid-September the clear biodegradable mulch was extremely brittle and quickly disappearing, having broken down into small pieces. The black biodegradable was also breaking down rapidly but still in larger pieces than the clear biodegradable. The buried edges of the biodegradable mulches were also weakening and becoming brittle—some trial disking of the biodegradable mulches at this time resulted in a fairly clean field with only small pieces of mulch left. The clear and black photodegradable mulches were showing long tears and cracks but still largely intact. Photodegradable mulch exposed to sunlight was brittle but buried edges were still tough (Table 3, September 12 readings).

Conclusions

The warm, wet growing season and dense vine cover favored the breakdown of the biodegradable mulches. By next spring it is expected that only small, insignificant pieces of biodegradable mulch will remain. The photodegradable mulches, on the other hand, will probably still have large ribbons that can blow around and tangle in equipment. Unfortunately, the clear biodegradable mulch was too fragile and difficult to use for muskmelon production (Dubois Agrinovation recommends it for early corn production and not for melon production). The black biodegradable mulch deserves more study because it wasn't too difficult to use, produced a good yield, and stayed mostly intact through harvest but broke down more quickly in the fall than the photodegradable mulches.

Table 1. Early and total muskmelon yield by mulch treatments.

	Early yield			Total yield		
Mulch treatment	Number fruit/acre	Cwt/acre	Fruit wt (lb)	Number fruit/acre	Cwt/acre	Fruit wt (lb)
Clear Biodegradable	3,214	173.54	5.5	5,177	300.25	5.8
Clear Photodegradable	2,592	146.79	5.7	4,665	307.79	6.6
Black Biodegradable	1,451	76.5	5.3	4,561	318.05	6.9
Black Photodegradable	2,515	135.24	5.4	5,080	317.53	6.3
Black Embossed	1,866	103.25	5.4	5,805	388.02	6.7
Trial Mean	2364	129.06	5.4	5,058	326.33	6.5
LSD .05%	804	46.5	n.s.	968	46.6	0.7

Table 2. Soil temperatures at 4 in. depth under mulch treatments[a].

Mulch treatment	8:00 a.m.	4:00 p.m.	Average
Clear Biodegradable	62.8	83.9	73.3
Clear Photodegradable	63.9	88.1	76.0
Black Biodegradable	61.8	79.1	70.5
Black Photodegradable	62.8	81.1	71.9
Black Embossed	62.8	80.9	71.8
Bare Ground	57.3	73.0	65.1
Air	56.5	69.6	63.1

[a]Average of six dates: May 7, 11, 15, 18, 22, and 25.

Table 3. Mulch strength readings in lbf (pound-force) required to puncture. All readings taken from top of mulch bed except September 12 taken on buried edges.

Mulch treatment	May 12	June 12	July 12	August 12	Sept. 12
Clear Biodegradable	0.8	0.5	0.2	0.1	0.0
Clear Photodegradable	1.4	1.3	1.1	0.7	0.7
Black Biodegradable	1.0	0.8	0.4	0.1	0.0
Black Photodegradable	1.1	1.0	0.8	0.6	0.5
Black Embossed	1.0	1.1	1.0	0.9	1.0